Books

La Théorie physique au Sens de Boltzmann et ses Prolongements modernes. By René Dugas. 308 pp. (Editions du Griffon, Neuchâtel) Dunod, Paris, France, 1959. 3700 fr. *Reviewed by R. Bruce Lindsay, Brown University.*

THE significant role which Ludwig Boltzmann played in the development of modern physics was recently re-emphasized in the brief biographical sketch of 1955 by Engelbert Broda. We now have before us from the hand of the late Maître de Conference of the Ecole Polytechnique of Paris a much more substantial critique of the scientific achievements of the great Viennese scientist. René Dugas made numerous valuable contributions to the history of mechanics in his later years and in this his last work he pays tribute to one of the founders of statistical mechanics in an analysis which has been based on a careful and thorough investigation and deserves close attention from all who are interested in the history and philosophy of physics.

Boltzmann was in some respects a tragic figure, who took all too seriously the scientific animadversions of his positivistic contemporaries like Mach and Ostwald. He believed in atoms and they did not. He had a strongly developed faith in the unfettered role of the human imagination in the creation of theories, a function whose worth was seriously doubted by many eminent physicists of his day, but which has eminently justified itself in the physics of the twentieth century.

Mr. Dugas provides first a fascinating nonmathematical review of Boltzmann's contributions to the critical study of the principles of mechanics, the general methods of theoretical physics, the theories of the school of energetics (represented by the rabid thermodynamicists), statistical mechanics, and philosophy. He then proceeds to a more detailed mathematical commentary on Boltzmann's gas theory, with the generalization of the Liouville theorem and the famous H theorem. This section concludes with a consideration of the statistical basis of the second law of thermodynamics and Boltzmann's rejoinders to the various objections raised to his views. The final section of the book is devoted to modern developments based on Boltzmann's work, including his relation to Gibbs, Poincaré, Planck, and Einstein. There is even a reference to the current controversy in the methodology of quantum mechanics between the Copenhagen school of indeterminists and the group represented by D. Bohm and J. P. Vigier, who believe that a deterministic version of quantum mechanics can ultimately be constructed. Dugas feels that Boltzmann, with his faith in bold intuitive insights as against the phenomenological, positivistic approach, would have sided with the latter group. This is an arguable point but it must be confessed it is very plausibly presented.

All who are interested in late 19th century and 20th century theoretical physics will enjoy this volume.

Probability and Related Topics in Physical Sciences. Vol. 1 of Lectures in Applied Mathematics: Proc. of Summer Seminar (Boulder, Colo., 1957). By Mark Kac with G. E. Uhlenbeck, A. R. Hibbs, Balth. van der Pol. 266 pp. Interscience Publishers, Inc., New York, 1959. $5.60. *Reviewed by J. Gillis, The Weizmann Institute of Science.*

DELIVERED at the Boulder Summer Seminar in 1957, this collection of lectures certainly makes delightful reading. The first four, by Kac, are respectively on the nature of probabilistic reasoning, some tools and techniques of probability theory, probability in some problems of classical statistical mechanics, and integration in function spaces and some applications. In these lectures both material and exposition are on the high level which could have been expected. The subjects are presented chiefly through examples and these have been selected for intrinsic interest, as well as for didactic value.

The bulk of the first lecture is devoted to the Littlewood-Offord theory of real roots of random polynomials and to an interesting excursus into prime number theory. The second lecture concentrates for its illustrations on a number of random walk problems. Throughout both of these lectures the aim seems to be to bring in as many powerful arguments as possible, for the edification and instruction of the student. The third lecture deals with the well-known problems of the connection between classical reversible mechanics and the Second Law of Thermodynamics. The author's own solution of the Ehrenfest problem appears, as does also the powerful and original method of Siegert and Hess. The fourth lecture presents a short and lucid account of the Wiener integral—certainly a long felt need—followed by some applications, including Feynman integrals and the Wigner-Kirkwood expansion of the quantum dynamical partition function.

Little is said of the foundations of probability theory; the emphasis is always on methods of analysis. As the author remarks in a footnote: "How much 'fuss' over measure theory is necessary for probability theory is a matter of taste. Personally, I prefer as little fuss as possible, because I firmly believe that probability theory is more closely related to analysis, physics and statistics than to measure theory as such."

Following the four lectures by Kac there is an appendix by Uhlenbeck on the Boltzmann Equation. This begins with a critical derivation and a careful discussion of its probable range of validity. The great interest in this equation of recent years is, to an important extent, the outcome of Uhlenbeck's own searching analyses. The next step is to discuss what happens at higher densities,

TWO NEW VOLUMES in the LANDAU-LIFSHITZ Course of Theoretical Physics

Ready in July

Vol. 1 ► MECHANICS

Translated by J. B. SYKES *and* J. S. BELL

The exposition is based upon the most general principles: Galileo's principle of relativity, and Hamilton's principle of least action. Topics treated include: the equations of motion, conservation laws, integration of the equations of motion, collisions between particles, small oscillations, motion of a rigid body, and the canonical equations.

c. 180 pp, 1960—probable price $7.50

Vol. 8 ► ELECTRODYNAMICS OF CONTINUOUS MEDIA

Translated by J. B. SYKES *and* J. S. BELL

Deals with the theory of electromagnetic fields in matter and the theory of the macroscopic electric and magnetic properties of matter. Chapter titles: electrostatics of conductors and dielectrics, constant current and magnetic field, ferromagnetism, superconductivity, quasi-static electromagnetic field, magnetic fluid dynamics, electromagnetic wave equations, propagation of electromagnetic waves, electromagnetic waves in anisotropic media, passage of fast particles through matter, electromagnetic fluctuations, scattering of electromagnetic waves, diffraction of x-rays in crystals.

c. 370 pp, 1960—probable price $12.50

Previously Published

Vol. 2 > THE CLASSICAL THEORY OF FIELDS

Translated by MORTON HAMERMESH

A systematic presentation of the theory of electromagnetic and gravitational fields.

354 pp, 12 illus, 1951—$10.00

Vol. 3 > QUANTUM MECHANICS—Nonrelativistic Theory

Translated by J. B. SYKES *and* J. S. BELL

Covers a wide range of problems in quantum mechanics which can be treated without the use of relativistic theory. *515 pp, 51 illus, 1958—$12.50*

Vol. 5 > STATISTICAL PHYSICS

Translated by E. PEIERLS *and* R. F. PEIERLS

An exposition of statistical physics and thermodynamics, completely rewritten and augmented from the original Russian edition. *496 pp, 1958—$12.50*

Vol. 6 > FLUID MECHANICS

Translated by J. B. SYKES *and* W. H. REID

Treats fluid mechanics as a branch of theoretical physics. Covers topics not usually found in such textbooks, e.g. heat transfer and diffusion in fluids, combustion, dynamics of superfluids, and relativistic fluid dynamics. *536 pp, 119 illus, 1959—$14.50*

Vol. 7 > THEORY OF ELASTICITY

Translated by J. B. SYKES *and* W. H. REID

Includes not only the ordinary theory of the deformation of solids, but such topics as thermal conduction and viscosity in solids, and problems in the theory of elastic vibrations and waves. *134 pp, 20 illus, 1959—$6.50*

Published by Pergamon Press, Ltd., London—IN THE U.S.A. AND CANADA, ORDER FROM

ADDISON-WESLEY PUBLISHING COMPANY, Inc.

Reading, Massachusetts, U.S.A.

when the Boltzmann equation certainly cannot tell the whole story, and the first part concludes with a heuristic exposition of the "hierarchy theory" as developed by Bogoliubov, Born and Green, Kirkwood and Yvon. The second part of the appendix presents Bogoliubov's ideas about the various stages of the approach to equilibrium with their respective relaxation times. Recent work of Choh, who carried out a number of calculations based on the Bogoliubov theory, is also reported.

The second appendix by Hibbs describes Feynman's path-integral method. This is followed by Appendix 3, by van der Pol, on smoothing and "unsmoothing". The problem concerns the recovery of a function from a moving average and leads through some beautiful work, involving two-sided Laplace transforms and Bernoulli polynomials, to explicit and practical results. The book ends with Appendix 4, also by van der Pol, on the finite difference analogy of the periodic wave equation and the potential equation. Like Appendix 3, it is illuminated by the author's clarity of exposition and zest for mathematics.

The rare combination of beautiful and useful material, lucidity and mathematical originality, which characterizes all the various contributions to this book, makes it a valuable addition to the literature on the subject.

Magnetic Materials: Magnetic and Electrical Properties. Suppl. No. 2 to Syst. No. 59, Iron, Part D of Gmelins Handbuch der anorganischen Chemie (8th Revised Ed.). 580 pp. Verlag Chemie, GmbH, Weinheim, Germany, 1959. Clothbound $78.24; paperbound $77.04. *Reviewed by C. Kittel, University of California at Berkeley.*

MANY solid-state physicists are not aware of the great usefulness of the Gmelins handbooks. The handbooks are monumental organized compilations of physical and chemical references and data on inorganic elements and compounds. Completeness appears to be the main goal; there is little direct attempt to give critical selections or evaluations of the data.

The present volume is concerned with magnetic materials, with particular emphasis on oxides, although only a little information on garnets is included. The presentation and illustration of actual data seem to be fairly random, and do not seem always to be motivated towards bringing out the central or fundamental physical facts about a material.

Atomic Energy in the Communist Bloc. By George A. Modelski. 226 pp. Melbourne U. Press for the Australian Nat'l U. Distributed in US by Cambridge U. Press, New York, 1959. $5.50. *Reviewed by James W. Moyer, General Electric Company.*

FOR those searching for a yardstick to evaluate our atomic energy programs in terms of our major competitor in the scientific Olympics, Mr. Modelski has provided a succinct and pithy review inviting comparisons on every page. Evident fairly exhaustive research of the technical and social literature has brought several aspects into rather sharp focus. The status of the known reactor programs, high-energy nuclear machines, raw materials, scientific manpower, intra-bloc cooperation, diffusion of Soviet policy, and atomic energy administration are topics all dealt with to an extent highly satisfying to the reader.

The book has a few limitations. Very little emphasis is given to the chemical and material technologies which we in the United States are finding to be our pacesetting factors, leading one to surmise that Modelski's chief scientific consultants were physicists. This omission is significant in that the reader is not provided with a feeling as to the communist bloc's capability for processing raw materials (the distribution of which he covers well) or the even more important capability for manufacture of fuel elements. In the latter case, one wonders whether the omission is based on a paucity of resource literature or an actual lack of sophistication in the art.

Realizing the omissions, however, does not blunt the appreciation for the guided tour of Russian policy formulation, with each significant signpost pointed out. Here we find that Russia is cluing her doctrinal expansion to electric power production, and we find the decisions to gain experience quickly from large reactor operation, to power the icebreakers, and to keep the development of industrial atomic energy entirely apart from weapon development. Compare these desiderata with our US policy of testing many types of reactors before settling on the large economy size, and the forbidding encouragement extended to private enterprise to reach this goal quickly, the struggle to apply nuclear propulsion even to the submarine, and the curious mixture of nonweapon and weapon-related research and development which appears in our large national laboratories. This is not to say that the Soviet approach is superior. The implication is clearly demonstrated in many parts of the book, however, that it must be easier for the communist policies to be carried *in their system*, than western policies *in our system!*

Modelski's view is that one basic weakness of the Soviet approach of concentrating resources on a few fields of technical development with high priority is to "undermine the balance of their economic structure because they deprive other vital parts of the economy of necessary resources" (p. 215). We are certainly not guilty of this!

As further comparisons, Modelski cites examples of important developments which parallel almost all of our projects, including their version of Plowshare. (This is almost the only mention of bombs.)

Diffusion of atomic technology outside Russia appears to be principally through technical education programs and limited technical assistance, especially where political ends are in sight. The gathering momentum of Red China's nuclear power is presented and, projecting not